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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/866,665	05/30/2001	Takaharu Kondo	35.C15382	5130

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EXAMINER	
MUTSCHLER, BRIAN L	

ART UNIT	PAPER NUMBER
1753	6

DATE MAILED: 05/09/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

VIF-6

Office Action Summary	Application No.	Applicant(s)	
	09/866,665	KONDO ET AL.	
	Examiner	Art Unit	
	Brian L. Mutschler	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-21 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-21 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 30 May 2001 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Specification

1. The abstract of the disclosure is objected to because the abstract should not refer to purported merits of the invention. Correction is required. See MPEP § 608.01(b).

2. Applicant is reminded of the proper content of an abstract of the disclosure.

A patent abstract is a concise statement of the technical disclosure of the patent and should include that which is new in the art to which the invention pertains. If the patent is of a basic nature, the entire technical disclosure may be new in the art, and the abstract should be directed to the entire disclosure. If the patent is in the nature of an improvement in an old apparatus, process, product, or composition, the abstract should include the technical disclosure of the improvement. In certain patents, particularly those for compounds and compositions, wherein the process for making and/or the use thereof are not obvious, the abstract should set forth a process for making and/or use thereof. If the new technical disclosure involves modifications or alternatives, the abstract should mention by way of example the preferred modification or alternative.

The abstract should not refer to purported merits or speculative applications of the invention and should not compare the invention with the prior art.

Where applicable, the abstract should include the following:
(1) if a machine or apparatus, its organization and operation;
(2) if an article, its method of making;
(3) if a chemical compound, its identity and use;
(4) if a mixture, its ingredients;
(5) if a process, the steps.

Extensive mechanical and design details of apparatus should not be given.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-18 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 3-10 and 16-18 contain the phrase "silicon-type thin film". The term "type" renders the claim indefinite because it is not clear what is meant by "silicon-type" or what is encompassed by "silicon-type". The same applies to dependent claims 2 and 11-15.

In claim 1 at line 6, claim 4 at line 7, and claim 10 at line 11, the phrase "based on that of silicon atoms" is indefinite because it is not clear what "that" refers to. It is suggested that "that" be changed to a more definitive term, such as "concentration". The same applies to dependent claims 2, 3, 5-9 and 11-15.

Claims 2, 6 and 12 recite the limitation "the flow rate" in line 3. There is insufficient antecedent basis for this limitation in the claims. It is suggested that the phrase be changed to "a flow rate".

In claims 1, 4 and 10, it was assumed by the Examiner that the concentration of oxygen is the concentration with regard to the entire material gas, as is common practice when referring to a concentration using units of ppm. If the concentration was intended to be a relative concentration of the oxygen with respect to the amount of silicon in the material gas, i.e., the concentration of oxygen is in units of parts per million silicon atoms, the 35 U.S.C. 103(a) rejection set forth in paragraph 6 and the obviousness-type double patenting rejection set forth in paragraph 13 could be further

taken in view of U.S. Pat. No. 5,556,794 and U.S. Pat. No. 6,028,264, both issued to Yamazaki. As described in paragraph 7 below, Yamazaki teaches a method for reducing the concentration of oxygen by adsorbing oxygen in the material gas to yield silicon thin films having concentrations overlapping the limits recited in the instant invention, which would inherently provide oxygen concentrations in the material gas containing the limits recited in claims 1, 4 and 10 of the instant invention.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1-4, 6, 7, 10, 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (U.S. Pat. No. 5,571,749), herein referred to as US '749.

US '749 discloses a method for producing silicon thin films, particularly for use in solar cells, using high-frequency plasma CVD (col. 15, line 9). US '749 discloses forming i-type silicon thin films using a material gas comprising silicon fluoride, hydrogen and oxygen (col. 15, lines 36-53; col. 33, line 60; col. 34, line 12). The flow rate of the hydrogen is usually much higher than the flow rate of the silicon containing gas (see Tables 1-5). The examples shown in US '749 are formed at pressures higher

than 50 mTorr (Tables 1-5). US '749 further discloses the use of oxygen-containing gases in the material gas mixture (col. 15, line 34).

The method and thin film of US '749 differs from the instant invention because US '749 does not disclose the concentration of oxygen contained in the material gas.

Semiconductor-grade silicon tetrafluoride gas (SiF_4) typically contains on the order of 20 ppm oxygen. Typical flow rate ratios of silicon-containing gases to hydrogen in the material gas for high-frequency plasma CVD methods range from around 1:20 to 1:150 or more. Based on the typical flow rate ratios, the concentration of oxygen in the material gas using semiconductor-grade silicon tetrafluoride would range from about 0.1 ppm to 1 ppm, which includes the range recited in claims 1, 4 and 10 of the instant invention.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method and silicon thin film of US '749 to use a material gas having an oxygen concentration of from 0.1 ppm to 0.5 ppm because using such an oxygen concentration would clearly lie within the scope of US '749.

7. Claims 5, 11, 16 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (US '749), as applied to claims 1-4, 6, 7, 10, 12 and 13, and further in view of Yamazaki (U.S. Pat. No. 6,028,264) and in view of Yamazaki (U.S. Pat. No. 5,556,794), herein referred to as US '264 and US '794, respectively.

US '749 discloses a method and silicon thin film having the limitations recited in claims 1-4, 6, 7, 10, 12 and 13 of the instant invention, as explained above in paragraph

6. US '749 further differs from the instant invention because US '749 does not disclose the formation of a thin film having an oxygen concentration from 1.5×10^{18} atoms/cm^3 to 5.0×10^{19} atoms/cm^3.

US '794 and US '264 teach methods for reducing the oxygen concentration in the layers of silicon thin films using molecular sieves or zeolites to adsorb oxygen when forming i-type layers solar cells having pin junctions (US '264 col. 6, line 20). US '264 teaches the formation of an i-type silicon thin film layer having an oxygen concentration less than 5.0×10^{19} atoms/cm^3 and as low as 5.0×10^{18} atoms/cm^3 (col. 6, line 26). US '794 teaches the formation of an i-type silicon thin film less than 5.0×10^{18} atoms/cm^3 or as low as 5.0×10^{15} atoms/cm^3 (col. 8, line 62; col. 9, line 44).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film of US '749 to use a thin film having an oxygen concentration of 1.5×10^{18} atoms/cm^3 to 5.0×10^{19} atoms/cm^3 as taught by US '264 and US '794 because oxygen in the intrinsic layer of solar cells act as donor centers and decreases the photo-sensitivity of solar cells (US '794 col. 3, lines 19-42).

8. Claims 8 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (US '749), as applied to claims 1-4, 6, 7, 10, 12 and 13, and further in view of Higashikawa (U.S. Pat. No. 6,252,158), herein referred to as US '158.

US '749 discloses a method and silicon thin film having the limitations recited in claims 1-4, 6, 7, 10, 12 and 13 of the instant invention, as explained above in paragraph 6. US '749 further differs from the instant invention because US '749 does not disclose

having a crystalline Raman scattering at least three times greater than the Raman scattering due to amorphous components.

Raman scattering shows the level of crystallization within silicon layers. The ratio of crystalline component to amorphous component gives a measurement for the crystal volume within the layer, i.e., a film having a crystalline component with a Raman scattering three times greater than the Raman scattering of the amorphous component has a crystal volume of 75%.

US '158 teaches a solar cell structure having several microcrystalline intrinsic layers with crystal volumes ranging from 30% to 99% (col. 11, line 66 to col. 12, line 3). Microcrystalline silicon solar cells avoid "the optical degradation phenomenon (Staebler-Wronski effect) specific to the amorphous semiconductors" (col. 2, lines 47-52).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film of US '749 to use a thin film having a crystalline Raman scattering three times greater than the amorphous Raman scattering, as taught by US '158, because a higher crystalline Raman scattering helps avoid the deleterious effects of optical degradation associated with amorphous semiconductors (US '158 col. 2, lines 47-52).

9. Claims 9 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (US '749), as applied to claims 1-4, 6, 7, 10, 12 and 13, and further in view of Kondo (U.S. Pat. No. 6,103,138), herein referred to as US '138.

US '749 discloses a method and silicon thin film having the limitations recited in claims 1-4, 6, 7, 10, 12 and 13 of the instant invention, as explained above in paragraph 6. US '749 further differs from the instant invention because US '749 does not disclose having a diffraction intensity of the (220)-plane comprising at least 50% of the total diffraction intensity.

US '138 teaches the use of thin films having diffraction intensities in the (220)-plane at least 30% of the total diffraction intensity because "the thin film will have notably improved carrier mobility" (col. 3, lines 37-40). US '138 further discloses specific examples of thin films having diffraction intensities in the (220)-plane from 50% to 60% relative to the total diffraction intensity (table 2).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the thin film of US '749 to use a thin film having a diffraction intensity in the (220)-plane at least 50% of the total diffraction intensity, as taught by US '138, because using such a thin film will have a "notably improved carrier mobility" (US '138 col. 3, lines 37-40).

10. Claims 17 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (US '749) in view of Yamazaki (US '264) and in view of Yamazaki (US '794), as applied to claims 5, 11, 16 and 19 above, and further in view of Higashikawa (US '158).

US '749, US '264 and US '794 describe a method and silicon thin film having the limitations recited in claims 5, 11, 16 and 19 of the instant invention, as explained above

in paragraph 7. US '749, US '264 and US '794 differ from the instant invention because they do not disclose having a crystalline Raman scattering at least three times greater than the Raman scattering due to amorphous components.

Raman scattering shows the level of crystallization within silicon layers. The ratio of crystalline component to amorphous component gives a measurement for the crystal volume within the layer, i.e., a film having a crystalline component with a Raman scattering three times greater than the Raman scattering of the amorphous component has a crystal volume of 75%.

US '158 teaches a solar cell structure having several microcrystalline intrinsic layers with crystal volumes ranging from 30% to 99% (col. 11, line 66 to col. 12, line 3). Microcrystalline silicon solar cells avoid "the optical degradation phenomenon (Staebler-Wronski effect) specific to the amorphous semiconductors" (col. 2, lines 47-52).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film described by US '749, US '264 and US '794 to use a thin film having a crystalline Raman scattering three times greater than the amorphous Raman scattering, as taught by US '158, because a higher crystalline Raman scattering helps avoid the deleterious effects of optical degradation associated with amorphous semiconductors (US '158 col. 2, lines 47-52).

11. Claims 18 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuda et al. (US '749) in view of Yamazaki (US '264) and in view of Yamazaki

(US '794), as applied to claims 5, 11, 16 and 19 above, and further in view of Kondo (US '138).

US '749, US '264 and US '794 describe a method and silicon thin film having the limitations recited in claims 5, 11, 16 and 19 of the instant invention, as explained above in paragraph 7. US '749, US '264 and US '794 differ from the instant invention because they do not disclose having a diffraction intensity of the (220)-plane comprising at least 50% of the total diffraction intensity.

US '138 teaches the use of thin films having diffraction intensities in the (220)-plane at least 30% of the total diffraction intensity because "the thin film will have notably improved carrier mobility" (col. 3, lines 37-40). US '138 further discloses specific examples of thin films having diffraction intensities in the (220)-plane from 50% to 60% relative to the total diffraction intensity (table 2).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the thin film described by US '749, US '264 and US '794 to use a thin film having a diffraction intensity in the (220)-plane at least 50% of the total diffraction intensity, as taught by US '138, because using such a thin film will have a "notably improved carrier mobility" (US '138 col. 3, lines 37-40).

Double Patenting

12. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA

1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

13. Claims 1-4, 6-10 and 12-15 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-16 of copending Application No. 09/865,549, herein referred to as App. '549. Although the conflicting claims are not identical, they are not patentably distinct from each other because the limitations recited in the instant invention are included in the claims of App. '549.

Claims 1, 2, 5, 6, 11 and 12 of App. '549 claim a method and silicon thin film formed using a silicon halide and hydrogen, wherein the silicon halide is a silicon fluoride. Claims 3, 7 and 13 recite the limitation that the flow rate of hydrogen is not less than the flow rate of the silicon halide. Claims 4, 8 and 14 recite the limitation that the pressure is 50 mTorr or more. Claims 9 and 15 recite the limitation that the Raman scattering from a crystalline component is at least three times greater than the Raman scattering from an amorphous component. Claims 10 and 16 recite the limitation that the percentage of diffraction intensity for the (220)-plane is at least 50% of the total diffraction intensity.

App. '549 differs from the instant invention because App. '549 does not disclose having oxygen present in the material gas at a concentration or from 0.1 ppm to 0.5 ppm.

Semiconductor-grade silicon tetrafluoride gas (SiF_4) typically contains on the order of 20 ppm oxygen. Typical flow rate ratios of silicon-containing gases to hydrogen in the material gas for high-frequency plasma CVD methods range from around 1:20 to 1:150 or more. Based on the typical flow rate ratios, the concentration of oxygen in the material gas using semiconductor-grade silicon tetrafluoride would range from about 0.1 ppm to 1 ppm, which includes the range recited in claims 1, 4 and 10 of the instant invention.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method and silicon thin film of App. '549 to use a material gas having an oxygen concentration of from 0.1 ppm to 0.5 ppm because typical silicon-containing gases contain oxygen, which when diluted with hydrogen using ratios common in the art, have oxygen concentrations which lie within the claimed range.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

14. Claims 5, 11 and 16-21 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-16 of copending Application No. 09/865,549 in view of Yamazaki (U.S. Pat. No. 6,028,264)

and in view of Yamazaki (U.S. Pat. No. 5,556,794), herein referred to as US '264 and US '794, respectively.

App. '549 discloses a method and silicon thin film having the limitations recited in claims 1-4, 6-10 and 12-15 of the instant invention, as explained above in paragraph 13. App. '549 further differs from the instant invention because App. '549 does not disclose the formation of a thin film having an oxygen concentration from 1.5×10^{18} atoms/cm^3 to 5.0×10^{19} atoms/cm^3.

US '794 and US '264 teach methods for reducing the oxygen concentration in the layers of silicon thin films using molecular sieves or zeolites to adsorb oxygen when forming i-type layers solar cells having pin junctions (US '264 col. 6, line 20). US '264 teaches the formation of an i-type silicon thin film layer having an oxygen concentration less than 5.0×10^{19} atoms/cm^3 and as low as 5.0×10^{18} atoms/cm^3 (col. 6, line 26). US '794 teaches the formation of an i-type silicon thin film less than 5.0×10^{18} atoms/cm^3 or as low as 5.0×10^{15} atoms/cm^3 (col. 8, line 62; col. 9, line 44).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the silicon thin film of App. '549 to use a thin film having an oxygen concentration of 1.5×10^{18} atoms/cm^3 to 5.0×10^{19} atoms/cm^3 as taught by US '264 and US '794 because oxygen in the intrinsic layer of solar cells act as donor centers and decreases the photo-sensitivity of solar cells (US '794 col. 3, lines 19-42).

This is a provisional obviousness-type double patenting rejection.

Conclusion

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (703) 305-0180. The examiner can normally be reached on Monday-Friday from 8:00am to 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (703) 308-3322. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

blm
April 29, 2002

ALAN DIAMOND
PRIMARY EXAMINER
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